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Astrid Grouls MD , Eberechi Nwogu-Onyemkpa MDMHS , Danielle Guffey MS , Subhasis Chatterjee MD , James P. Herlihy MD , Aanand D. Naik MD

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Palliative Care Impact on COVID-19 Patients Requiring Extracorporeal Membrane Oxygenation

Authors: Astrid Grouls, MD; Eberechi Nwogu-Onyemkpa, MD, MHS; Danielle Guffey, MS; Subhasis Chatterjee, MD; James P. Herlihy, MD; Aanand D. Naik, MD

Affiliations:
Corresponding Author: Grouls – Department of Medicine, Section of Geriatrics and Palliative Medicine, Baylor College of Medicine, Houston, Texas, USA; Orcid 0000-0001-9596-9591
Mailing Address: One Baylor Plaza; MS:BCM680; Houston, TX 77030-3411
Email Address: astrid.grouls@bcm.edu

Nwogu-Onyemkpa - Department of Medicine, Section of Geriatrics and Palliative Medicine, Baylor College of Medicine, Houston, Texas USA; Orcid 0000-0002-5140-449X

Guffey - Institute for Clinical and Translational Research, Baylor College of Medicine, Houston, Texas, USA; ORCID 0000-0003-3721-614X

Chatterjee - Divisions of General and Cardiothoracic Surgery, Michael E. DeBakey Department of Surgery, Baylor College Medicine. Department of Cardiovascular Surgery, Texas Heart Institute, Houston, Texas, USA; Orcid 0000-0002-0803-8826

Herlihy, Department of Medicine, Section of Pulmonary, Critical Care and Sleep Medicine, Baylor College of Medicine, Houston, Texas, USA
ORCiD: 0000-0002-6918-1167

Naik – Department of Management, Policy, and Community Health (MPACH), University of Texas School of Public Health; UTHealth Consortium on Aging; and VA Center of Innovations, DeBakey VA Medical Center, Houston, Texas USA. Orcid 0000-0001-6936-7984

Running Title: Palli COVID ECMO

Abstract

Context: Patients with severe respiratory failure from COVID-19 refractory to conventional therapies may be treated with extracorporeal membrane oxygenation (ECMO). ECMO requirement is associated with high mortality and prolonged hospital course. ECMO is a high-resource intervention with significant burdens placed on caregivers and families with limited data on the integration of palliative care consultation (PCC).

Objectives: To explore the role of standard versus automatic PCC in the management of COVID patients on ECMO.

Methods: Retrospective chart review of all COVID patients on ECMO admitted from March 2020 through May 2021 at a large volume academic medical center with subsequent descriptive analysis

Results: Forty-eight patients were included in the analysis. Twenty-six (54.2%) received PCC of which 42% of consults automatically initiated. PCC at any point in admission was associated with longer duration on ECMO (24.5 v 37 days; $p < 0.05$). Automatic PCC resulted in more family meetings than standard PCC (0 v 3; $p < 0.05$) and appears to trend with reduced time on ECMO, shorter length of stay, and higher DNAR rates at death, though results were not significant. Decedents not receiving PCC had higher rates of no de-escalation of interventions at time of death (31% v 11%), indicating full intensive care measures continued through death.

Conclusions: Among patients with COVID-19 receiving ECMO, PCC may be associated with a shift to DNAR status particularly with automatic PCC. There may be a further impact on length of stay, duration of time on ECMO and care plan at end of life.

Key Message: Additional research is warranted regarding automatic palliative care consult early in the ECMO course for patients with COVID, as it may reduce length of stay, time on ECMO and increase DNAR rates when compared to standard consult models.

Editorial Comment:
Debra Parker Oliver, PhD
We continue to learn from the COVID pandemic and this paper presents a unique opportunity to understand the ECMO experience.

Key Words: palliative care; ECMO; COVID-19

Introduction

The coronavirus disease 2019 (COVID-19) has resulted in over 6.2 million deaths worldwide with almost 1 million in the United States as of April 2022.(1) Up to 5% of patients experience critical illness requiring ICU admission. (2, 3) After conventional therapies have been exhausted for patients with severe acute respiratory disease syndrome (ARDS) for patients with COVID-19, the most critically ill patients may require extracorporeal membrane oxygenation (ECMO) for additional management as a bridge to recovery or transplant. (4) ECMO offers extracorporeal life support by draining deoxygenated blood from the patient (inflow cannula) through a large-bore venous cannula into a circuit consisting of a pump and oxygenator before returning the oxygenated blood (outflow cannula) back via another large bore venous cannula into the patient's circulation. ECMO availability for the management of COVID patients is associated with reduction in mortality for eligible patients from 90% to 43%. (5)

The major international organization for ECMO, the Extracorporeal Life Support Organization (ELSO) issued recommendations in 2020 calling for consideration of palliative care consultation (PCC) for all COVID patients requiring ECMO. (6) PCC is already utilized in about 19% of ECMO cases in the US for patients on ECMO for respiratory failure, cardiogenic shock, thoracic transplantation, amongst other indications. (7) Various studies highlight the prolonged hospitalization course of both survivors and decedents requiring ECMO for COVID, often over a month. (8, 9) PCC is known to play a role in the care of patients with chronic critical illness, and early integration may be helpful in family-centered ICU care when patients are on ECMO.(10) Given the sudden onset of the COVID pandemic and the unique and relatively broad application of ECMO in tertiary care settings for the management of COVID, there was at that time no data regarding the impact of automated PCC on patient outcomes, despite the recommendation that PCC be routinely applied for this patient cohort. Moreover, the family visitation restrictions from COVID-19 safety protocols posed additional challenges to overcome.

The main objective of this study was to describe the role of automatic PCC for COVID patients requiring ECMO, with comparison to a cohort receiving standard (case-based referral) PCC earlier in the pandemic. A secondary objective was to describe the variation in patient outcomes, notably length of stay and code status at time of death, with and without palliative care.

Methods

Baylor-St. Luke's Medical Center is a 650-bed academic tertiary care hospital in the Texas Medical Center in Houston, Texas. Prior to the pandemic, the palliative care service consisted of two nurse practitioners and a part-time chaplain. Two board-certified palliative care physicians were added to the PCC service in August and September 2020, respectively. Prior to and early in the pandemic, there was no process in place for automatic PCC for any patients requiring ECMO, and consults were initiated sporadically on a case-based nature by determination of the intensivist managing the patient, which we will refer to as "standard" PCC. Standard PCC included as needed family meetings as agreed upon by the intensivist and PC team.

COVID patients initiated on ECMO received automatic activation of the COVID ECMO pathway beginning December 10, 2020, which included automatic PCC. The ECMO intensivist would inform social work and the unit director when a COVID patient was placed on ECMO, activating an interdisciplinary team (IDT) to meet weekly to discuss all patients on ECMO and establish goals and criteria that would indicate improvement (Figure 1). The social worker reached out to the identified surrogate to set up routine

weekly family meetings via video conference, which focused on overall medical status of the patient, with an emphasis on the nature of ECMO, potential outcomes, and progress toward established weekly goals. PC participated in all meetings, engaged in goals of care as needed outside of these pre-scheduled meetings and provided additional support as requested by the primary team. Weekly family meetings continued until the patient was weaned off ECMO, died, or per family preference. After weaning from ECMO, PC did continue to follow patients if requested by the patient, family or medical team.

Study Design

Retrospective chart review of all COVID patients requiring ECMO was completed for a period from March 1, 2020 through May 30, 2021. After this time period, there was a notable decline in the number of patients requiring ECMO for management of COVID at our institution. All adult patients started on ECMO for a confirmed COVID diagnosis were included, including those initiated on ECMO for COVID elsewhere who remained on ECMO upon transfer. Patients for whom ECMO was initiated for reasons unrelated to COVID were excluded from this study.

Data collected for all patients included demographics, religious preference, admission date, date of ECMO initiation, comorbidities on admission, survival to discharge, and time on ECMO.

PCC was confirmed via the associated EMR order. All PC notes were reviewed to confirm reason for consult, number of PC encounters, number of family meetings involving PC, and the actions taken by the PC team. Actions included identification of the correct surrogate, assisting with end-of-life transition, symptom management outside of the end-of-life period, discussion of goals of care and code status, engagement of PC chaplain (spiritual support) and counseling and support for families. This information is consistently captured in standard PC documentation, but as it is not documented consistently outside of PCC, actions such as frequency of family meetings and chaplain engagement could not be reliably captured when PC was not involved.

For those patients who died during the hospital admission, further chart review was performed to capture nature of death and code status at time of death. Two clinician consensus was utilized to capture if patient care at the time of death constituted de-escalation or withdrawal of therapies (eg ECMO or pressor discontinuation), no escalation (eg no addition of new medications/therapies) or full care/no de-escalation (addition of all resuscitative measures or interventions as needed per the treating team). This was considered independent of code status at time of death.

Demographic data is presented with descriptive analyses. Wilcoxon Rank Sum was utilized in light of small sample size for the analysis of demographics, outcomes and palliative care role. Medians are presented with associated 25^{th}-75^{th} interquartile range (IQR) where possible. A $p < 0.05$ was considered statistically significant. Statistical analyses were performed using Stata v 15.1 (StataCorp LLC, College Station, TX, USA).

Results

Forty-eight patients were identified who met the inclusion criteria and required ECMO for the management of COVID during the study period. PCC was ordered for 26 patients (54%). Demographics and comorbidities are demonstrated in Table 1 for patients with and without PCC. There was a significant difference in racial composition between groups ($p = 0.04$) without substantial difference in those identifying as Hispanic (63.6% v 69.2%, $p = 0.76$).

Overall survival was 33% and median length of stay was 39 days (Table 2). Not shown are that survival rates changed over time, with the initial rate of 60% survival dropping to 20% when comparing the earliest 10 and the latest 10 cases in the cohort. Frequency of PCC over time increased, with two of the first 20 admitted patients receiving PCC, compared to 100% of the patients admitted in 2021, mostly via the automatic PCC. There was a significant difference in median length of stay between survivors (60.5 d, IQR 39-76) and decedents (34 d, IQR 24 – 49.5, p = 0.004).

Among decedents, 85% of patients not receiving and 89% of patients receiving PCC had a DNAR code status at the time of death (Table 2). With automatic PCC, DNAR rates were 100% compared to 82% with standard PCC. Decedents not receiving PCC had higher rates of no de-escalation of interventions at time of death (31% v 11%), indicating full intensive care measures continued through the time of death. All patients with automatic PCC transitioned to withdrawal of life support interventions at the time of death rather than dying without escalation or on full intensive care measures. Survival on ECMO for those with automatic PCC was 27%, similar to the 27% for those receiving standard PCC, and there was no statistically significant difference in survival among those with and without PCC.

With automatic PCC, median days on ECMO reduced to 34 from 52 as compared to standard PCC, with reduction in median length of stay from 64 to 35 days. These changes were not statistically significant. Patients receiving PCC spent statistically significantly more days on ECMO (median 24.5 days v 37, p = 0.03). PCC occurred on average 16 days into ECMO initiation for all patients receiving PCC, with a reduction in median time to consult of 14 to 9 days with automatic consultation, relative to ECMO initiation (p = 0.15; Table 3).

PCC resulted in an average of 10 patient encounters, with no significant change in median visit frequency between the cohort with and without automation, though palliative care was involved in significantly more family meetings when automatic (0 v 3, p = 0.03).

Palliative care was primarily involved in goals of care (100%), counseling and support (100%), and surrogate identification (89%), with no overall statistically significant difference in documented activities.

Discussion

In this study, we highlight the development of automatic palliative care consultation via an interdisciplinary team support pathway for COVID patients on ECMO and their families, and began to identify differences in patient outcomes and clinical trajectories with and without PCC. PCC was associated with longer duration on ECMO. PCC had no significant impact on survival or length of stay. Automatic PCC resulted in more involvement of PC in family meetings as compared to standard PCC, without a change in overall visits, time to consult or role of PC.

The role of automatic PCC in COVID-positive patients on ECMO has received little exploration despite clear recommendations for PC involvement. One prior study by Rao et al explored the role of automated PCC for 23 COVID patients on ECMO. (8) The population in the Rao study was similar to ours – primarily young, Hispanic men. Rao et al described primarily offering psychosocial support and counseling, surrogate identification, and pain and non-pain symptom management (83% of patients). While they found that PCC had no impact on survival, they did not capture hospital course or nature of death. Rao et al additionally acknowledged the need for further investigation regarding the role of PCC for this highly morbid population.

In our study, there are some notable trends that did not reach statistical significance indicating the importance of further study with a larger cohort. Automatic consultation shifted both length of stay (64 to 35 days) and days on ECMO (52 to 34 days) as compared to standard PCC without a substantial change in overall survival. Notably, decisions to discuss withdrawal of life-sustaining therapies with families were approached only after consensus by the interdisciplinary team. These trends suggest an abbreviated hospital course, potentially with more rapid shift to withdrawal of life support interventions. We believe a larger patient cohort, ideally multi-institutional, is warranted to further explore the potential changes in clinical course when palliative care is automatically consulted. It is possible that a larger sample size in the study cohort may have demonstrated statistically significant outcomes for these parameters. This potential for a substantial reduction in length of stay and ECMO utilization without impact on survival is critical given the resource-intensive nature of ECMO. Since the start of this study, our institution has implemented automatic consultations for palliative care for ECMO for COVID-19 and after extracorporeal CPR (eCPR) based on the favorable experience.

This study found that PCC was associated with longer duration on ECMO though the IQR's highlight the wide range of experiences of patients for those receiving ECMO. This and the IQR for time on ECMO until consultation demonstrate the range of duration the intensive care team chose to wait to consult PC without automation. While we believe this increase in time on ECMO stems primarily from delays in time to routine PCC, self-selecting for those patients who did not survive and had shorter courses, additional study is warranted here as well.

The authors speculate that PCC may be associated with increased rates of DNAR and transition to more natural death (specifically withdrawal or no escalation), particularly with automatic PCC, though the reason for this is unclear. It is possible that this formal process may help families accept clinical futility at an earlier juncture. We believe timely initiation of PCC through automatic triggers may be a key factor that increases rates of DNAR and decisions to withdraw life-sustaining therapies, though we acknowledge causation cannot be determined and a larger cohort is needed for further exploration.

When consulted, PC participated in goals of care conversations for all patients, and further assisted with code status discussion, counseling and support, and surrogate identification. While this was similar to the role of PCC in patients on VA ECMO for cardiogenic shock (11), this contrasted with Rao et al, who reported a higher rate of involvement in symptom management (83% for both pain and non-pain symptom management) though the authors did not distinguish end-of-life symptom management from symptom management at other times in the hospitalization. In our institution, active management of sedatives and opioid drips while intubated was deferred to intensivists, with PC involved in end-of-life symptom management, which we considered distinct, given its complexity.(12, 13)

Again, a key limitation in this study is the small sample size. The included patients were essentially all patients requiring ECMO due to COVID from the start of the pandemic through May 2021, regardless of changes in ECMO initiation criteria during that time. Given the size of the ECMO program at this institution, multi-institutional data or a national data bank are needed to have more robust assessment on this small patient population. That said, the development of the IDT support pathway and automatic consultation during the course of the pandemic organically created a cohort of patients within the same institution for comparison that did and did not receive PCC. A further limitation was the addition of board-certified palliative care physicians to the palliative care service about 5 months into the pandemic. It is unknown how addition of physician leadership impacted PCC – 24 patients were started on ECMO before the addition of physicians to the PC team, of whom only 3 received PCC, all standard.

Given data was collected as a retrospective chart review, there was also no opportunity to proactively collect data that could prove valuable in the future, such as a survey of family and provider satisfaction at the time of the case.

Conclusion

We present a retrospective cohort report of COVID patients requiring ECMO who did and did not receive PCC. Automatic PCC in a structured protocol results in more family meetings with palliative care engaged, without significant impact on survival. Further research on the changes in length of stay, duration of time spent on ECMO and nature of death with PCC is warranted given the high resource utilizing nature of ECMO. Further studies to fully capture patient, family and clinician experience with automated PCC are additionally warranted.

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Table 1. Demographics and Comorbidities of patients stratified by Palliative Care Consultation

	All (48)	No PCC (22)	All PCC (26)	P value (No v All PCC)
Age (y), Mean (SD)	48.4 (10.4)	50.1 (11.2)	47.0 (9.6)	0.31
Male, N (%)	35 (72.9)	14 (63.6)	21 (80.8)	0.21
Race, N (%)				0.04
White	38 (79.2)	14 (63.6)	24 (92.3)	
Black	3 (6.3)	2 (9.1)	1 (3.8)	
Other/Undisclosed	7 (14.6)	6 (27.3)	1 (3.8)	
Hispanic, N (%)	32 (66.7)	14 (63.6)	18 (69.2)	0.76
Religion, N (%)				0.14
Christian, undefined	15 (31.3)	6 (27.3)	9 (34.6)	
Baptist	7 (14.6)	1 (4.5)	6 (23.1)	
Pentecostal	2 (4.2)	0 (0.0)	2 (7.7)	
Catholic	20 (41.7)	12 (54.5)	8 (30.8)	
Hindu	1 (2.1)	1 (4.5)	0 (0.0)	
Muslim	1 (2.1)	1 (4.5)	0 (0.0)	
Other	2 (4.2)	1 (4.5)	1 (3.8)	
Comorbidities, N (%)				
Hypertension	23 (47.9)	13 (59.1)	10 (38.5)	0.25
Diabetes Mellitus	11 (22.9)	5 (22.7)	6 (23.1)	0.99
Chronic Obstructive Pulmonary Disease/Asthma	3 (6.3)	2 (9.1)	1 (3.8)	0.59
Smoking (Active), N=44	2 (4.5)	1 (4.8)	1 (4.3)	0.99
Immunosuppression	13 (27.1)	7 (31.8)	6 (23.1)	0.53
Pregnant/Peripartum (%Women), N=13	2 (15.4)	1 (12.5)	1 (20.0)	0.99
COVID Vaccination	0 (0.0)	0 (0.0)	0 (0.0)	-
Age >= 50 y	27 (56.3)	15 (68.2)	12 (46.2)	0.15
Obese (BMI >= 30)	28 (58.3)	12 (54.5)	16 (61.5)	0.77

Body Mass Index, Mean (SD)	33.3 (7.2)	34.0 (8.0)	32.8 (6.6)	0.58
Palli Consult, N (%)	26 (54.2)	-	-	
Advance Care Planning Documentation in Electronic Medical Record on Admission, N (%)	2 (4.2)	0 (0.0)	2 (7.7)	0.49

Table 2. Survival, hospital course and decedent outcomes

	All (48)	No PCC (22)	All PCC (26)	p-value (No v Palli)	Standard PCC (15)	Automatic (11)	p-value (Pre and Post)
Survival, N (%)	16 (33.3)	9 (40.9)	7 (26.9)	0.37	4 (26.7)	3 (27.3)	0.99
ECMO Days into Admission, Median (IQR)	6 (1, 10)	6.5 (1-10)	5 (1-11)	0.86	6 (1-11)	4 (1-11)	0.82
Days on ECMO (#), Median (IQR)	28 (15.5, 54.5)	24.5 (12-29)	37 (25-68)	0.03	52 (25-68)	34 (6-69)	0.32
Length of Stay (days), Median (IQR)	39 (28.5, 65)	39 (30-46)	49.5 (27-76)	0.25	64 (27-76)	35 (25-81)	0.52
Decedents (N)	**32**	**13**	**19**		**11**	**8**	
DNAR at Death, N (%)	28 (87.5)	11 (84.6)	17 (89.5)	0.99	9 (81.8)	8 (100.0)	0.49
Withdrawal at Death, N (%)	23 (71.9)	8 (61.5)	15 (78.9)	0.38	7 (63.6)	8 (100.0)	0.40
No escalation at Death, N (%)	3 (9.4)	1 (7.7)	2 (10.5)		2 (18.2)	0 (0.0)	
No de-escalation at Death, N (%)	6 (18.8)	4 (30.8)	2 (10.5)		2 (18.2)	0 (0.0)	

Table 3. Palliative Role and Consult Timing

	Standard PCC (15)	Automatic PCC (11)	p-value
Palliative Care Role, N (%)			
Goals of Care	15 (100.0)	11 (100.0)	1
Code Status	10 (66.7)	5 (45.5)	0.43
Counseling and Support	14 (93.3)	11 (100.0)	0.99
End of Life Transition	3 (20.0)	5 (45.5)	0.22
Pain Management	3 (20.0)	1 (9.1)	0.61
Non-Pain Symptoms	3 (20.0)	2 (18.2)	0.99
Surrogate Identification	12 (80.0)	11 (100.0)	0.24
Spiritual Support	4 (26.7)	4 (36.4)	0.68
Identified Surrogate, N (%)			0.54
Spouse	11 (73.3)	7 (63.6)	
Parent(s)	1 (6.7)	2 (18.2)	
Child(ren)	3 (20.0)	1 (9.1)	
Sibling	0 (0.0)	1 (9.1)	
Family Meetings, Median (IQR)	0 (0-1)	3 (1-3)	0.03
Palliative Care Visits, Median (IQR)	6 (3-17)	9 (3-19)	0.66
Days in Admission for Consult, Median (IQR)	15 (9-29)	9 (4-24)	0.19
Days into ECMO for Consult, Median (IQR)	14 (3-27)	9 (1-6)	0.15

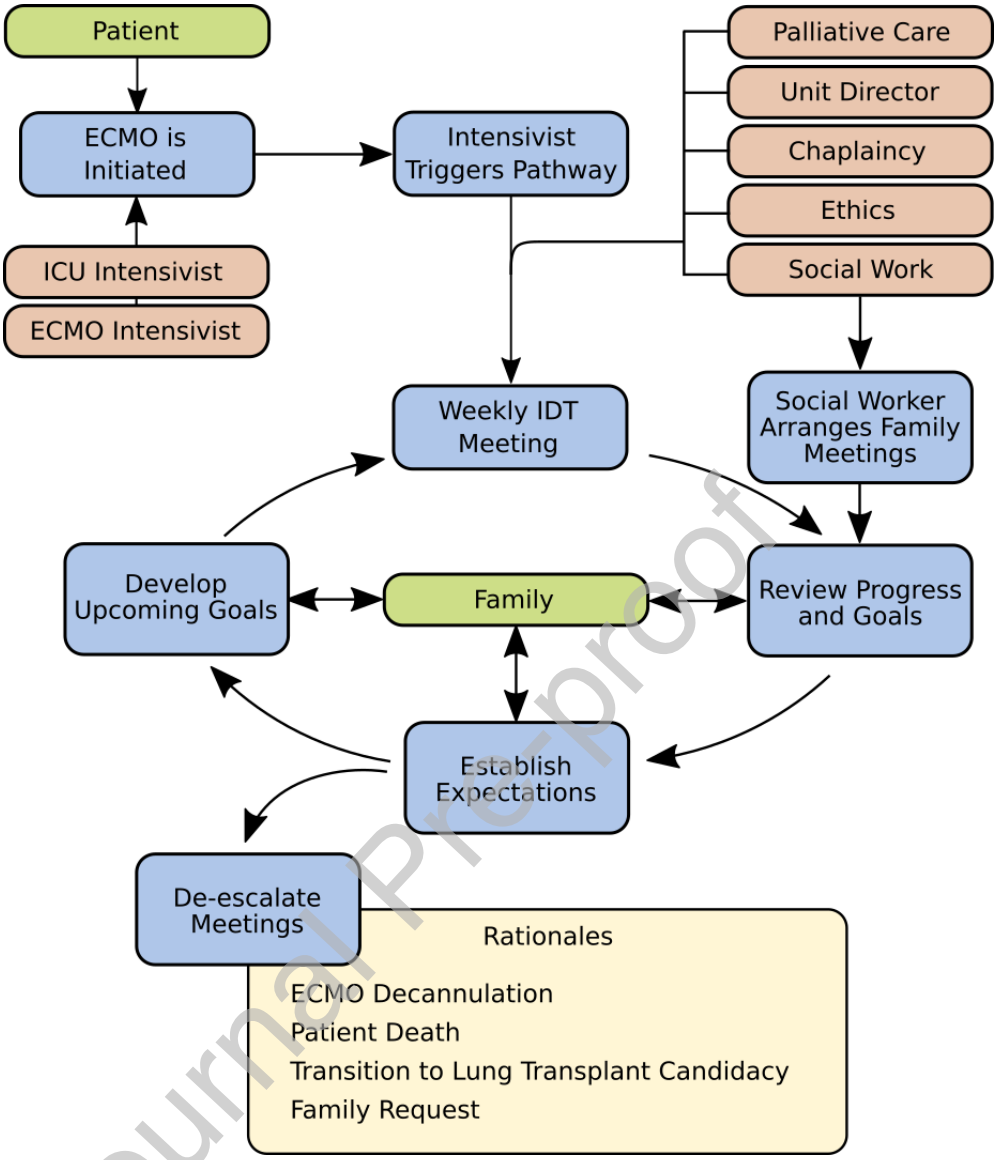

Figure 1. Model of the COVID ECMO Pathway including Automated PCC

Extracorporeal Membrane Oxygenation (ECMO), ICU (Intensive Care Unit), Interdisciplinary Team (IDT)

IDT Includes all team members in pink